

PATENT SPECIFICATION

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(19)



(54) IMPROVEMENTS IN OR RELATING TO AERIAL ELEMENTS AND ARRAYS

(71) We, THE MARCONI COMPANY LIMITED, a British Company, of Marconi House, New Street, Chelmsford, Essex CM1 1PL do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

10 This invention relates to aerial elements and arrays and in particular to such elements and arrays used in electronic scanning systems.

Many electronic scanning systems require the provision of aerial elements which produce a circularly polarised field and have a primary pattern shape, a band width, power handling and efficiency which is acceptable whilst not involving high manufacturing costs. The necessity to ensure that the cost of the element is not unduly high will be understood when it is considered that a single array used for electronic scanning may contain several thousand identical aerial array elements.

Known aerial arrays for electronic scanning systems use a multiplicity of waveguide horns of square cross section containing individual waveguide circularisers or a multiplicity of quadrature-fed disc radiators or a multiplicity of crossed dipoles or slots with quadrature balun feeds. Whilst satisfactory as regards their electrical performance such arrangements are relatively expensive to manufacture. A more economical solution is the use of arrays of helices or spirals, but such arrangements are often found to be unsatisfactory as regards their performance because of excessive mutual coupling.

The present invention seeks to provide improved aerial elements and aerial element arrays which are relatively cheap to manufacture whilst of satisfactory electrical performance.

According to this invention an aerial element comprises a spiral radiator for generating a circularly polarised field arranged to energise a cruciform aperture in a screening member.

Accordingly an aerial array in accordance with the present invention comprises a plurality of spiral radiators for generating a circularly polarised field each being arranged to energise an individual cruciform aperture in a screening member. Normally the screening member is common to all the spiral radiators.

Normally again means are provided between the spirals in an array for preventing direct coupling between the individual spiral radiators in the array.

The cruciform apertures may take a number of different forms e.g. two crossing slots of uniform width throughout their lengths, two crossing slots each of which is of dumb bell shape or two crossing slots each of which is of a width which tapers towards their middle portion.

Each spiral radiator may also take a number of different forms, e.g. circular or square. The spirals may be Archimedean (that is to say of constant pitch) or equiangular (that is to say of logarithmic pitch). Normally each radiator will have the form of a single spiral although balanced (that is to say double) spirals may be used.

Preferably each spiral radiator is a printed circuit conductor. In an array in accordance with the present invention all of the printed circuit conductors may be carried on the same base. Preferably a ground plane conductive member is provided, spaced from the under-surface of said printed circuit base and preferably again said screening member is spaced from said printed circuit base by the means for screening the spiral radiators one from another. The last mentioned means may

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comprise conductive posts or spacers or they may be dividing walls of solid or mesh construction. The space between the spiral radiators and the cruciform apertures may be air or dielectric filled.

The invention is illustrated in and further described with reference to the drawing accompanying the provisional specification in which,

Figure 1 is a cross section through part of an aerial element array in accordance with the present invention

Figure 2 illustrates three different forms of cruciform aperture which may be provided in the screening member used in the present invention and

Figure 3 illustrates two different forms of spiral radiator which may be used in carrying out the invention.

Referring to Figure 1 the printed circuit base 1 has formed thereon a printed spiral radiator 2. Spaced from spiral radiator 2, and not shown in the figure, may be other spiral radiators in rows and columns as required to provide an array suitable for electronic scanning. All of the spiral radiators are formed on the same printed circuit base 1. Immediately beneath (as viewed) printed circuit 1 is a conductive ground plane member 3 through which a lead 4 passes. Lead 4 is connected to spiral radiator 2 to enable the same to be energised. Similarly leads are provided for each of the spiral radiators (not shown). Immediately above (as viewed) spiral radiator 2 is a cruciform aperture 5 in a screening member 6. In this case cruciform aperture 5 has a form as shown at (a) in Figure 2. In conductive screening member 6 similar cruciform apertures (not shown) are provided for each of the other spiral radiators in the array. The screening member 6 is spaced from printed circuit base 1 by conductive posts 7. The conductive posts 7 are arranged in rows and columns between the rows and columns of spiral radiators. The conductive posts 7 act to shield the spiral radiators, one from another, so as to reduce direct coupling. The free end of each spiral radiator may be provided with a lossy termination if necessary, but in many cases the free ends may be left open circuited. In the embodiment shown in Figure 1 the space 8 between the spiral radiator and the cruciform aperture 5 is air filled.

As has already been mentioned, Figure 2 illustrates three of the different parts of cruciform apertures which may be used in carrying out the present invention.

Referring to Figure 3, this shows two forms that the spiral radiator 2 may take. In the case of the spiral radiator shown at (a) the spiral is of square form and Archimedean. In the case of the spiral

radiator shown at (b) the spiral is circular and Archimedean. It is assumed that a spiral radiator as shown at (b) in Figure 3 is used in the arrangement of Figure 1.

WHAT WE CLAIM IS:—

1. An aerial element comprising a spiral radiator for generating a circularly polarised field arranged to energise a cruciform aperture in a screening member.
2. An aerial array comprising a plurality of spiral radiators for generating a circularly polarised field each being arranged to energise an individual cruciform aperture in a screening member.
3. An array as claimed in claim 2 and wherein the screening member is common to all the spiral radiators.
4. An array as claimed in claim 2 or 3 and wherein means are provided between the spirals in an array for preventing direct coupling between the individual spiral radiators in the array.
5. An aerial element or array wherein the or each cruciform aperture comprises two crossing slots of uniform width throughout their lengths.
6. An aerial element or array wherein the or each cruciform aperture comprises two crossing slots each of which is of dumb bell shape.
7. An aerial element or array wherein the or each cruciform aperture comprises two crossing slots each of which is of a width which tapers towards their middle portion.
8. A aerial element or array as claimed in any of the above claims and wherein the or each spiral radiator is circular.
9. An aerial element or array as claimed in any of the above claims 1 to 7 and wherein the or each spiral radiator is square.
10. An aerial element or array as claimed in any of the above claims and wherein the or each spiral radiator is Archimedean.
11. An aerial element or array as claimed in any of claims 1 to 9 and wherein the or each spiral radiator is equiangular.
12. An aerial element or array as claimed in any of the above claims and wherein the or each spiral radiator is double and is balanced.
13. An aerial element or array as claimed in any of the above claims and wherein the or each spiral radiator is a printed circuit conductor.
14. An array as claimed in claim 13 wherein all of the printed circuit conductors are carried on the same base.
15. An array as claimed in claim 14 and wherein a ground plane conductive member is provided, spaced from the under-surface of said printed circuit base.
16. An array as claimed in claim 14 or 130

15 and wherein said screening member is spaced from said printed circuit base by the means for screening the spiral radiators one from another.

5 17. An array as claimed in claim 16 and wherein said last mentioned means comprise conductive posts or spacers.

18. A array as claimed in claim 16 and wherein said last mentioned means comprise dividing walls of solid or mesh
10 construction.

19. An aerial array substantially as herein described with reference to the drawing accompanying the provisional specification.

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1 SHEET

PROVISIONAL SPECIFICATION

This drawing is a reproduction of
the Original on a reduced scale.

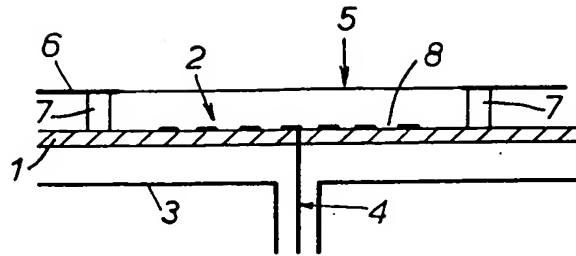


FIG. 1.

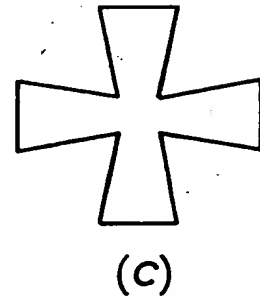
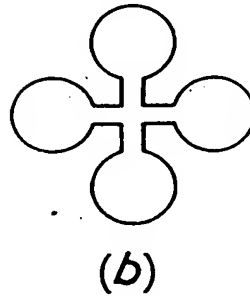
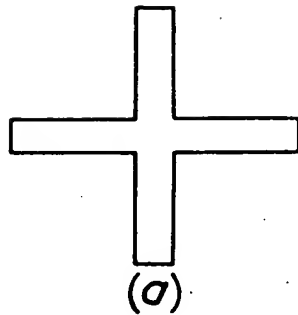


FIG. 2.

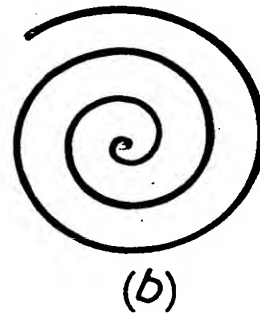
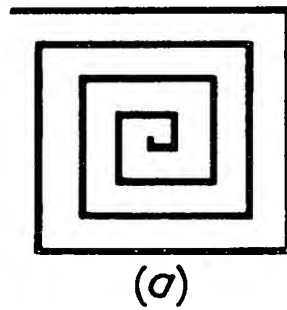


FIG. 3.

PATENTS ACT 1949

SPECIFICATION NO 1390514

The following amendments were allowed under Section 29 on 1 December 1976

Page 1, line 88, *after* by *delete* the

Page 4, lines 89, 93 and 97, *after* array *insert* as claimed in any of the above claims 1 to 4

Page 5, line 3, *delete* the in first occurrence

THE PATENT OFFICE
14 January 1977

Bas 31469/14

ERRATUM

SLIP NO 2

SPECIFICATION NO 1390514

Page 2, line 49, *after* direct *delete* count *insert* coupl

THE PATENT OFFICE
9 February 1977

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